CLAIMS

What is claimed is:

1) A method of determining the pH of a sample, comprising:
   a) Determining an infrared spectrum of the sample;
   b) Determining the concentration of hemoglobin of the sample;
   c) Selecting a model relating an infrared spectrum to pH that is applicable for samples having the determined hemoglobin concentration;
   d) Determining the pH of the sample from the infrared spectrum and the selected model.
2) A method as in Claim 1, wherein the model comprises regression coefficients relating an infrared spectrum to sample pH.
3) A method as in Claim 1, wherein the model comprises a model determined from calibration data collected from samples with hemoglobin levels spanning the range of sample hemoglobin levels.
4) A method as in Claim 1, wherein the model comprises a model determined from hemoglobin-specific regression coefficients applied to calibration data collected from samples with hemoglobin levels that do not span the sample hemoglobin range.
5) A method as in Claim 1, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in at least one of transmission, diffuse reflectance, transflectance, ATR.
6) A method as in Claim 1, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in at least one of transmission, diffuse reflectance, transflectance, ATR.
7) A method as in Claim 1, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in the spectral frequency range from 4000 – 25000 cm-1.
8) A method as in Claim 1, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in the spectral frequency range from 4000 – 8000 cm-1.
9) A method as in Claim 1, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in the spectral frequency range from 6000 – 6500 cm-1.
10) A method as in Claim 1, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation at a spectral resolution of 64 cm-1 or finer.
11) A method as in Claim 1, wherein determining the concentration of hemoglobin comprises at least one of:

a) Direct measurement of a blood sample using an external instrument or method;

b) Spectroscopic measurement of a blood sample; and

c) Noninvasive measurement of perfused tissue.

12) A method as in Claim 1, wherein determining the concentration of hemoglobin comprises at least one of:

a) Measuring the sample hemoglobin concentration under physiological conditions that are not undergoing rapid change;

b) Accounting for errors introduced by potentially interfering intravascular substances.

13) A method as in Claim 1, wherein the sample comprises at least one of:

a) A blood sample drawn from the patient;

b) A blood sample measured intravascularly (indwelling measurement);

c) Perfused tissue;

d) Perfused skin;

e) An ex vivo blood sample in a transmission vessel;

f) An ex vivo blood sample in a transflectance vessel;

g) A blood sample in an on-line flow circuit;

h) In situ measurement of a perfused tissue; and

i) In situ measurement of a perfused organ or muscle.

14) A method of determining pH of a sample, comprising:

a) Determining an infrared spectrum of the sample;

b) Verifying that the spectrum is spectrally consistent with the calibration model;

c) Determining the concentration of hemoglobin of the sample;

d) Determining the pH of the sample from the infrared spectrum, the determined hemoglobin, hematocrit, or equivalent concentration, and a model relating an infrared spectrum and associated hemoglobin concentration to pH.

15) A method as in Claim 14, wherein the model comprises regression coefficients relating an infrared spectrum to sample pH.

16) A method as in Claim 14, wherein the model comprises a model determined from calibration data collected from samples with hemoglobin levels spanning the range of sample hemoglobin levels.

17) A method as in Claim 14, wherein the model comprises a model determined from hemoglobin-specific regression coefficients applied to calibration data collected from samples with hemoglobin levels that do not span the sample hemoglobin range.

18) A method as in Claim 14, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in at least one of transmission, diffuse reflectance, transflectance, ATR.

19) A method as in Claim 14, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in at least one of transmission, diffuse reflectance, transflectance, ATR.

20) A method as in Claim 14, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in the spectral frequency range from 4000 – 25000 cm-1.

21) A method as in Claim 14, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in the spectral frequency range from 4000 – 8000 cm-1.

22) A method as in Claim 14, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation in the spectral frequency range from 6000 – 6500 cm-1.

23) A method as in Claim 14, wherein determining an infrared spectrum comprises measuring the sample absorbance of infrared radiation at a spectral resolution of 64 cm-1 or finer.

24) A method as in Claim 14, wherein determining the concentration of hemoglobin comprises at least one of:

a) Direct measurement of a blood sample using an external instrument or method;

b) Spectroscopic measurement of a blood sample; and

c) Noninvasive measurement of perfused tissue.

25) A method as in Claim 14, wherein determining the concentration of hemoglobin comprises at least one of:

a) Measuring the sample hemoglobin concentration under physiological conditions that are not undergoing rapid change;

b) Accounting for errors introduced by potentially interfering intravascular substances.

26) A method as in Claim 14, wherein the sample comprises at least one of:

a) A blood sample drawn from the patient;

b) A blood sample measured intravascularly (indwelling measurement);

c) Perfused tissue;

d) Perfused skin;

e) An ex vivo blood sample in a transmission vessel;

f) An ex vivo blood sample in a transflectance vessel;

g) A blood sample in an on-line flow circuit;

h) In situ measurement of a perfused tissue; and

i) In situ measurement of a perfused organ or muscle.

27) An apparatus for determining the pH of a sample, comprising:

a) An illumination system adapted to direct radiation to the sample;

b) A collection system adapted to receive radiation expressed from the sample responsive to incident radiation;

c) An analysis system, comprising a model relating two or more of radiation expressed, incident radiation, and hemoglobin concentration to sample pH.

28) An apparatus as in Claim 27, wherein:

a) The infrared radiation encompasses the spectral frequency range between 4000 – 25000 cm-1;

b) Infrared radiation is delivered to the sample through at least on of: optical fibers, light guides, and imaging optics;

c) Hemoglobin concentration is determined using radiation in the spectral frequency range from 10,000 – 25,000 cm-1; and

d) pH is determined using radiation in the spectral frequency range from 4,000 – 10,000 cm-1 combined with the hemoglobin concentration.

29) An apparatus for determining the pH of a sample, comprising:

a) Means for determining an infrared spectrum of the sample;

b) Means for determining the concentration of hemoglobin of the sample;

c) Means for selecting a model relating an infrared spectrum to pH that is applicable for samples having the determined hemoglobin concentration;

d) Means for determining the pH of the sample from the infrared spectrum and the selected model.